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ACADEMY OPENS HEADQUARTERS OFFICE

The President and the Board of Managers of the Washington Academy of Sciences takes pleasure in announcing to the members of the Academy the establishment of its first central office, at 1530 P Street, NW., Washington 5, D. C. The telephone is ADams 4-5323.

For some time the Board has recognized that the growth of the Academy and the increased scope of its activities would make it necessary to set up an office at a fixed address where its business operations would be conducted. At the Board's 499th meeting on April 16, 1957, the Policy and Planning Committee recommended and the Board unanimously voted that, "It shall be the policy of the Academy to establish a headquarters office in Washington, preferably in cooperation with its affiliated societies." In the ensuing months of 1957 President Rubey and members of the Executive Committee explored various possible locations and arrangements for a headquarters office without success, owing to the shortage of space such as the Academy was looking for.

Early in 1958 a special committee on headquarters was appointed as follows: Frank M. Setzler, chairman; Howard S. Rappleye, Leo Schubert, B. F. Scribner, Raymond J. Seeger, Atherton Seidell, and Joseph Still. This committee looked into many possibilities. Finally, in May, the Academy's need came to the attention of the staff of the Carnegie Institution of Washington. Having been impressed by the scientific program of the Academy, the Institution made arrangments for a room in its building to be assigned to the Academy. This room, No. 101, is immediately to the right of the entrance on P Street. The offer of this room was gratefully accepted.

In June the Executive Committee appointed James I. Hambleton, recently retired from the Agricultural Research Service, U. S. Department of Agriculture, as a consultant to set up and staff the office. Mr. Hambleton called upon the officers of the Academy and reviewed with them their various activities to determine what operations should initially be undertaken at the headquarters and what records and materials should be kept there. He then procured and installed the essential furniture of the office, including more than 200 feet of steel shelving for back issues of the JOURNAL of the Academy, etc. At the same time he interviewed candidates for employment in the new office.

The Executive Committee met in the new office on July 3 and appointed Mrs. Mary L. Fell, a graduate of the University of Virginia, as staff officer, and designated President-Elect Frank L. Campbell to assume general oversight of the office. Mrs. Fell has had extensive experience in editorial work, writing, teaching, and office operations and is especially well qualified for the varied duties of the position with the Academy. Mrs. Fell came on part-time duty on July 18, and, by the time this announcement reaches the readers of the JOURNAL, she will have become familiar with many of the operations of the Academy and will be on duty full time, 8:30 to 5:30, Monday through Friday. The building and the office will be closed evenings, and on Saturdays, Sundays, and holidays.

Hereafter, those having business with the Academy should write or telephone to the office at 1530 P Street, NW. To avoid confusion the name of the Carnegie Institution is not to be used in the address.

The telephone, ADams 4-5323, is on a separate line and does not go through the Carnegie Institution switchboard. If, for any reason, Mrs. Fell cannot be reached by phone, any urgent messages for her may be left at Dr. Frank L. Campbell's office at the National Academy of Sciences.

The new headquarters office will serve as the mailing address of the Joint Board on Science Education, which is sponsored jointly by the Academy and the D. C. Council of Engineering and Architectural Societies and conducts or coordinates all the activities of the area having to do with the promotion of science education.

The officers of the Academy take this opportunity publicly to thank Dr. Rubey and members of his Board who initiated the plan for the headquarters and did much preliminary exploration, and Mr. Setzler and members of his committee who were successful in locating a home for the Academy. Special thanks go to the staff of the Carnegie Institution for providing the space needed by the Academy in a building so well suited for its headquarters.

LIFE HISTORY OF MEADOWLARK

The meadowlark, described as "the most characteristic bird of the American farm," is a homesteader. Early each spring the male "stakes out" an area of 6 to 200 acres which is guarded as the exclusive domain of himself and his family—he may have two or three wives—until the start of the next winter. This territorial exclusiveness is described by Dr. Alfred O. Gross, noted American ornithologist, in a bulletin recently issued by the Smithsonian Institution.

The meadowlark, Dr. Gross says, hardly can be considered a migrant, as are some of its relatives. With the coming of winter, however, it retreats a hundred miles or more southward from the northern limits of its range in southern Canada. Usually about the middle of March the birds start northward again.

"The first migrants," says Dr. Gross, "are old males, few in number and quiet in manner, which have wintered far to the south. By the end of March the migrant males become abundant. The first resident males arive in the latter part of March. They are active in the mornings and late afternoon, but during midday they often retire to a common feeding ground which the birds from different territories share without any apparent hostility."

But this "era of good feeling" is brief. The females arrive in waves about two weeks after the males. Their coming, says the bulletin, stimulates the first song peak of the males whose songs become longer, more brilliant and animated. Just before this, however, "the resident male leaves his companions and selects a territory, preferably a grassland or meadow, because of the great abundance of food as well as his decided liking for this type of habitat.

"The size and shape of the territory depend chiefly on the area of suitable land available, the local abundance and strength of competing males, the relative concentration of food supply, and certain barriers and individual range requirements of the male. The size of the territory may be increased as a result of polygamous relations, particularly if the females choose widely separated nesting sites, but the average size of 15 territories at Ithaca, N. Y., was found to be about 7 acres. The more concentrated the food supply the less need there is for foraging and the smaller the area frequented.

"Of two territories studied by G. B. Saunders throughout the breeding season of 1931, one contained 9 and the other 20 acres; but due to the abundance of food in a meadow separating the two families, one monogamous and the other with three females, this common feeding ground was shared.

"Important to the male are the various commanding perches from which he can survey his territory. He selects one for his primary headquarters. Here he sings and watches during the day, usually roosting nearby at night. This territorial center is frequented faithfully during the entire season, unless his routine is changed by polygamy, in which case secondary headquarters are often established nearer his mates. As he may have as many as three females, each having two broods, the chief center of interest in the territory may change as each female reaches the peak of sexual responsiveness.

"By intimidating songs and alarms, displays and disputes, the male meadowlark defends his domain against rivals. It is clear from the beginning of his tenure that the male has a definite conception of his territorial acreage and chases all resident males of his species beyond these boundaries. The competitors may come to blows, but it is usually a matter of vehement displays or competitive singing, ending when the vanquished bird takes wing. The loser may be pursued rapidly beyond the boundary line; the victorious male then returns to the sentinel station, singing a spirited flight song as he flies."

During the courtship period, Dr. Gross relates, there is intense rivalry. Two rival males have been seen tumbling about on the ground on their backs with their feet firmly locked together, striking at each other with their bills in mortal combat. The courtship, Dr. Gross continued, is featured by elaborate displays, spectacular flights and intensive singing. An instance is recorded where a male, on his headquarters perch, sang steadily for 19 minutes with an average of 11 songs per minute. The soughtafter female often answers each song with a soft, conversation-like chatter.

The meadowlark is primarily a bird of the grass lands, meadows, and pastures. Its nests, however, occasionally are found in corn, alfalfa, and clover fields and in grassed islands among plowed fields. Most of the nests have a dome-shaped roof constructed of grass more or less interwoven with the attached and growing parts of the clump of grass or weeds against which it is built. Sometimes there is a covered passageway leading to the nest, especially in a field where the tall grass was not cut during the previous season.

Some of the nests are so well hidden that they are very difficult to find and are discovered only when the bird is flushed by the accidental approach of somebody walking through the field.

Shortly after hatching the nestling reacts to the food call of the mother and holds up its mouth in a wobbly, uncertain fashion. By the third or fourth day a slitlike opening appears in the eyelids so that the nestling can see when it is fed or disturbed. The eyes are fully opened on the fifth day. By the eighth day the youngster is very alert. They may be seen frequently preening their feathers. During the remaining days in the nest they become so active that the nest is wrecked and the roof torn away, exposing the nestlings to the hot direct rays of the sun. When thus exposed they pant violently in order to control their temperature. Sometimes they leave the nest and by the eleventh or twelfth day they take their final leave. The stage now is set for the appearance of a second brood.

The rapid progress true science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the height to which may be carried, in a thousand years, the power of man over matter. We may perhaps learn to deprive large masses of their gravity, and give them absolute levity, for the sake of easy transport. Agriculture may diminish its labor and double its produce; all diseases may by sure means be prevented or cured, not excepting even that of old age, and our lives lengthened at pleasure even beyond the antediluvian standard. O that moral science were in as fair a way of improvement, that men would cease to be wolves to one another, and that human beings would at length learn what they now improperly call humanity!—BENJAMIN FRANKLIN, in a letter to Joseph Priestley, February 8, 1780.

PHILOSOPHY.—*On scientist and theologian?* LEO FRANCIS KOCH, University of Illinois. (Communicated by C. H. Page)

(Received July 11, 1958)

The attempt by Dr. Raymond J. Seeger in his article *Scientist and Theologian?* (this JOURNAL. **48:** 145–152. 1958) to destroy the myth of separation of science and values is noteworthy but not effective. The title itself is indicative of a dualistic philosophy in which the role of the theologian is favorably compared to that of the scientist.

Having made this initial assumption, Seeger properly concludes that "it is my personal belief that from a practical point of view there are two spheres which will never be either completely separated or wholly coincident, but will always overlap to some degree" (p. 146).

"Evidently," he writes, "it is necessary right at the start to have clear concepts of both science and theology." But then he contradicts himself by saying: "It would certainly be presumptuous for me to speak for theology. Accordingly I will limit my definition to science and merely indicate those features that it appears to have in common with theology, and those emphases which seem distinctive to it." Evidently we are to take the words of theologians at their face value but not those of scientists.

This already less than ideal situation is aggravated by Seeger's disclosure that "certain theologians have a tendency to use symbolically common words with multiple meanings for certain specific fringe-meanings. In this connection, science undoubtedly has a great advantage. When necessary, it can and does introduce entirely new words which it sharply defines" (p. 148). From this observation, it would seem that Seeger has done just the opposite of what common sense would dictate. If theological concepts are ambiguous, they should be clarified; if scientific concepts are sharply defined, why redefine them?

Alas, the answer is clear that the more ambiguous the definitions, the easier it will be to establish the overlapping of science and theology, of which he speaks.

And so with Seeger, we ask "What is science?" He answers, "Science is the result of the use of a scientific method. What, however, is a scientific method? It is a method used by a scientist." He continues, "In a similar fashion, I believe, one can say that theology is the result of the use of a theological method, and that a theological method is a method used by a theologian (it would not be impossible, though not desirable, to speak of theology as a science)" (p. 147).

Such a bit of circular reasoning I have not encountered since reading E. W. Sinnott's *The biology of the spirit.* I strongly recommend Sinnott's book as a source for all the logical fallacies in their simplest and starkest forms.

The excuse for this follows: "In order that this phraseology may not appear to be merely a play upon words, may I say that I am trying to emphasize in both instances the 'what' as being less important than the 'how,' and the 'how' as being less valuable than the 'who.' It is the scientist and the theologian themselves who are most significant."

Seeger's plan of analysis takes form. He has now established that the scientist and the theologian are both human beings! Then, "After noting this personal involvement, we consider next our sense impressions. First of all, we realize that all our views are based on an underlying assumption as to the uniformity of nature, not only those views of scientists but also those of theologians, for whom dependability is a sina qua non" (p. 147). Yes, he concludes, both human beings have identical sense organs and therefore perceive their environments in a similar manner.

On the next page (148) comes the coup d'état: "Out of the empirical earth, we move up into the rational atmosphere, where we all make a common basic assumption; namely the intelligibility of the universe." The identity is complete. The only difference Seeger has noted between science and theology is that (p. 147) "the differences

(in phenomena) that make for individuality, I believe are emphasized by theology, whereas the generic similarities are stressed by science."

What, may I ask, has happened to the much-discussed objectivity of science? Is empirical experimentation no longer the primary basis of science? If so, what is to account for the striking progress of scientists in the past three centuries contrasted with the striking lack of progress by theologians?

The going is even rougher when Seeger attempts to classify attitudes that one may take toward getting answers to philosophical questions. "One may claim dogmatically, 'We don't know.' Such people are agnostics. Sceptics say doubtfully, 'We do not know, but ...' Still others urge hopefully, 'We do not know, but we are finding out more and more.' Such is the attitude of all faithful men; of men who believe that the answers are to be found in our material environment, or in man himself, or in very God. The first group of believers may be called materialists (scientists?); the second group, humanists (scholars of the humanities?); the third, men of religion."

The trichotomy is clear; name your poison! If a scientist is not a humanist or man of religion, then he must be a materialist, and presumably also a dogmatic agnostic! The materialist category obviously includes such diverse theories as mechanism, vitalism, naturalism, scientism, and positivism.

The "Vitalistic-Mechanistic Controversy" has been discussed at length by me in the *Scientific Monthly* of November 1957. In that article I tried to indicate that modern scientists quite generally employ process concepts, or as John Dewey might have said, the transactional view, instead of any lineal descendant of vitalism or mechanism.

In Seeger's trichotomy it is clear that a materialist and a humanist are mutually exclusive categories and that he himself is bridging the unbridgeable gap. He uses humanism in its Renaissance sense, as it is used by many scholars of the humanities. As an example one might cite Howard Mumford Jones. Unfortunately, many of these self-styled humanists are almost as antiscientific as their theological brethren. One of them is Karl Shapiro, a philosopher of some reputation who wrote an article *Why Out-Russia Russia?* recently for the *New Republic* (June 9, 1958). His biased view of science and scientists is nicely shredded in letters to the editor in several subsequent issues.

Seeger might have been helpful if he had explored the potentialities of more modern varieties of naturalistic or religious Humanism, which in this country are organized as the American Humanist Association, with headquarters at Yellow Springs, Ohio. Many Unitarians and Universalists as well as the Ethical Culturists are of Humanistic convictions, which are based on scientific knowledge rather than antagonistic to it. Such Humanism might well be the basis for a healthful synthesis of the materialistic or naturalistic and humanistic lines of thought implied by Seeger.

Outstanding examples of spokesman for such a Humanistic outlook, or way of life, are John Dewey, especially in his book, *A common faith*, and Corliss Lamont, in a recent paperback volume, *The philosophy of humanism*. A Nobel prizewinner, Hermann J. Muller, noted geneticist and professor at the University of Indiana, is now president of the American Humanist Association.

The most unsatisfactory link in Seeger's chain of reasoning is his unqualified acceptance of the "very God" as one of his three alternatives, without any proper designation of what he might mean by that term. It is customary among most people to interpret a word in its usual, or commonly accepted, dictionary-sense if it is not specifically defined in context. Therefore one must conclude that Seeger is a theist of the orthodox variety, or neo-orthodox subvariety.

One might rationalize such a conclusion because it is well known that Christians, so-called, use the term God arrogantly, as if there were only one valid concept of it. It so happens that the Christian sect is a minority group among the great religious organizations of the world, and to speak as if it were the only important one is certainly the height of presumption.

Quite in line with Seeger's classification of attitudes toward getting answers to philosophical questions, is his trinitarian group of philosophies. "Each one of us, therefore,

has apparently three practical choices: (1) to be agnostic and thereby maintain an intellectual vacuum in which moral commitments are meaningless—negativism, (2) or to note indiscriminately all possibilities so that moral commitments are neutralized—positivism, (3) or to proceed wholeheartedly to develop one viewpoint—metaphysics" (p. 151).

Apparently a metaphysician in this sense is anyone who has the gumption to hold an opinion other than agnostic or positivistic. But a positivist certainly may "proceed wholeheartedly" to develop his viewpoint and so is a special kind of metaphysician if we apply Seeger's definition. The dichotomy of positivism versus metaphysics arose with Comte, the originator of the organized positivistic school, who expressly repudiated all other views as essentially "theological" or "metaphysical."

Comte used the term in the Kantian sense as referring to a realm of pure reason, separate from the material realm—a dualistic system, in other words. Seeger, apparently, would prefer to use the term metaphysics in a more modern sense, as the "analysis of experience, in the broad sense," as delimited in the unabridged Merriam-Webster dictionary (p. 1546, 1934 ed.).

Note that in Comte's sense of the term, a scientific philosophy would be a form of positivism and opposed to a metaphysical view, whereas in Seeger's analysis, science would be lumped with the metaphysical point of view and opposed to the positivists. With one bold stroke, Seeger has accomplished his aim, that of reducing scientific philosophy to a level with theology as if both were merely insignificant variations of a central theme of faith in something.

This desired unity, or overlapping of science and theology is explicit in these two statements (p. 147): "First of all we realize that all (sic!) our views are based upon an underlying assumption as to the uniformity of nature, not only those views of scientists but also those of theologians, ..." (p. 148) and "Out of the empirical earth, we move up into the rational atmosphere, where we all (sic!) make a common basic assumption; namely the intelligibility of the universe."

It is most curious that the staunchest advocates of the orderliness of the universe and its intelligibility are among the religionists, most of whom believe in the existence of a supreme being, who is the almighty creator and sovereign of that universe. At one and the same time they believe in a dependable universe, behaving in accordance with materialistic laws, and yet they also believe that this universe is subject to the whim and fancy of a being with unmistakable anthropomorphic characteristics. Apparently the orderliness of the universe is matched only by the disorderliness of the human intellect.

Although it is perfectly true that the scientist, the theologian, the historian, and the philosopher, among others, all have one common subjectmatter to investigate, in Seeger's phrase, "man and his environment," it is nonetheless also true that each of these specialists relies upon a certain method of investigation, and consequently produces a type of knowledge which is uniquely different. To say that all men share certain characteristics of physique, emotions, and mind is to state a biological fact. But to conclude from that that the scientist as a scientist is merely a kind of metaphysicist is to murder the English language and set back knowledge about 1500 years.

The present widespread illusion that values are not influenced by science must be dispelled rapidly if western civilization is to continue in a position of cultural leadership. The values inherent in science and scientific method, however, are not necessarily identical to the values of theology.

Values inherently implicit in science are primarily those which can be derived from a knowledge of the biological nature of man. Survival values are basic for all living organisms but in man's social evolution, certain ethical values are equally important. Group survival and individual survival are not always completely in agreement and very often certain individual values related to freedom must be sacrificed in favor of group survival.

Values associated with the practice of scientific method are not quite in the same category as survival values unless one is willing to grant that survival itself is now

totally dependent on the practice of scientific method. Only an extreme scientism or advocate of some faddist cult with a pseudo-scientific orientation would make such a claim. Nevertheless, the leaders of western civilization and people generally have much to learn about scientific attitudes and how they may help us to extricate ourselves from the present moral and ethical impasse which may yet lead us to destruction.

If Dr. Seeger's address on *Scientist and theologian?* did nothing else than to stimulate serious thought about this crucial social problem, it certainly has been worthwhile and a valuable contribution to social evolution.

WORM BEHAVIOR

Worms, supposedly almost at the bottom of animal life, are creatures of rhythms and moods. They sulk, loaf, and have bursts of extreme activity. Their lives, like those of many higher organisms (perhaps including man), seem to be regulated by "internal clocks." This is reported by Dr. G. P. Wells, zoologist of the University of London, in the most recent annual report of the Smithsonian Institution.

Dr. Wells has studied particularly lugworms, creatures about the size of a fountain pen, which are found at low tide by digging in beaches of muddy sand. These worms live in a fairly permanent burrow, eating the sand, digesting some of the organic content, and ejecting the unwanted remainder on the surface. These residues collect as a heap of sandy cylinders, familiar to many beach frequenters.

The lugworm, Dr. Wells reports, has a brain—of sorts. This is small and the nervous system is quite simple. The creature leads an extremely sheltered life, surrounded by sand which is both its food and its protection. Owing to these facts one would expect to find its behavior quite simple.

For example, [says Dr. Wells] one might expect it to start eating when its stomach is empty, go on until the stomach is full, and then stop, and make a backward trip to the surface to shoot out a sand cylinder as soon as the intestine is loaded. But the facts are quite otherwise. Under natural conditions it feeds in little bursts, each lasting for a few minutes, with rests of a minute or so between. If you watch it in a glass tube of sea water without any sand to eat you often see a similar alternation of feeding movements and rest. The important point is that each of the outbursts subsides although there has been no satisfaction by eating.

Again under natural conditions a lugworm moves backward to the surface and shoots out a sand cylinder once about every 40 minutes. A fasting worm in a glass tube can often be seen to make similar backward trips although it has no urge in the form of residues of sand to discharge. It looks as if the worm had 'physiological alarm clocks' in its organization which go off spontaneously every so often, irrespective of its needs, and compel it to make a burst of feeding movements or a backward trip.

In the case of the feeding rhythm the 'alarm clock' has been located. If you remove the front part of the esophagus, put it in a dish of sea water, and watch it carefully you see that this little fragment of the worm has a complicated automatic rhythm of its own. For a few minutes it is vigorously active, with waves of contraction running along it in regular sequence from the front end to the back, then it becomes quiet for a couple of minutes, and so on.

It can be shown quite convincingly that this behavior of the esophagus is the cause of the intermittent feeding of the intact worm. When the esophagus is active its activity spreads through the nervous system to most of the muscles of the body, affecting them in various ways and producing periodic feeding movements.

The actual mechanism of the clock, Dr. Wells says, still cannot be explained adequately, any more than the exact mechanism of the heart beat, which it somewhat resembles.

The lugworm is a creature of moods. This is shown clearly, Dr. Wells says, by automatic recordings of its movements and other behavior. Alternatively it may lie still and do nothing, make violent, chaotic wriggles and other rhythmic patterns, apparently quite apart from feeding behavior. One of these "moods" generally is persistent for several hours, Dr. Wells says, and then passes suddenly into another.

"It looks," he says, "as if the lugworm's behavior is governed mainly by an elaborate internal organization, perhaps even up to the level of the long-term changes of mood. The same can be said of other marine worms. Their activities are patterned in time, sometimes with strikingly regular rhythms and changes of mood. The regular patterns are characteristic of the species. Each has its own characteristic kind of wriggle."

MYCOLOGY.—*Some new or rare Discomycetes from South America.* EDITH K. CASH, Crops Research Division, Agricultural Research Service, United States Department of Agriculture.

(Received June 5, 1958)

Most of the fungi discussed below are among a collection of Discomycetes made by Dr. E. J. H. Corner in South America in 1948. Among them two species from Brazil, two from Bolivia, and one from Peru appear to be undescribed and are therefore named here as new. In addition, the occurrence of a rare Discomycete collected by the late Roland Thaxter in Trinidad is reported, and a new species of *Mollisiella*, also from that locality, is described. Type specimens of the new species are deposited in the National Fungus Collections, Beltsville, Md.

1. **Dasyscypha chermisina,** sp. nov.

Apothecia sparsa, stipitata, globosa dein cupuliformia usque patellata, molle carnosa, 0.2–1 mm in diametro, testaceo-rubra, albotomentosa, hymenio chermisino, margine pallide roseo, stipite 0.1–0.2 × 0.1 mm; asci cylindrici, brevi-stipitati, ad apices obtusi, poro ope iodi caerulescenti, octospori, 40–45 × 3–3.5 μ; ascosporae aciculares, unicellulares, hyalinae, 20–26.4 × 0.5–0.7 μ; paraphyses rectae, rigidae, ascos superantes, ad apices angustatae, 55–60 × 1 μ; excipulum prosenchymaticum, pallidum, pilis hyalinis, verrucosis, 60–90 × 2 μ, ad apices non inflatis, interdum exsudato brunneo in caespitulis agglutinatis obsitum.

Apothecia scattered, stipitate, occasionally nearly sessile, globose then cupulate to applanate when old, soft fleshy, 0.2–1 mm in diameter, stem and exterior Japan rose to terra cotta[1] in dried specimens, Chatenay pink to shell pink toward the margin, white tomentose, hymenium deep Corinthian red to carmine; stipe 0.1–0.2 × 0.1 mm, concolorous with the exterior; asci cylindrical, short stipitate, obtuse at the tips, pore bluing with iodine, 8-spored, 40–45 × 3–3.5 μ; ascospores acicular, unicellular, hyaline, 20–26.4 × 0.5–0.7 μ; paraphyses erect, stiff, exceeding the asci, pointed at the tips, 55–60 × 1 μ; exciple hyaline, prosenchymatic; excipular hairs hyaline, verrucose, 60–90 × 2 μ, not swollen at the apex, sometimes agglutinated in tufts by a brownish exudate.

On dead petioles of *Alsophila* sp., Brazil: Corcovado, Rio de Janeiro, December 19, 1948, E. J. H. Corner *1225*.

This species on *Alsophila* petioles differs from *Dasyscypha ulei* Wint. and *D. dicranopteridis* Seaver & Whetz., two red species found on fern stipes, in the stipitate apothecia and longer, narrower ascospores, as well as in the host.

2. **Mollisiella trinitensis,** sp. nov. (Fig. 1)

Apothecia 0.2–0.5 mm in diametro, hypophylla in stromatibus atris orbicularibus 1–1.5 mm in diametro, singula vel caespitosa, cupulata, molle carnosa, fusca usque atro-olivacea, tenuiter pulverulenta, hymenio griseo-citrino usque griseo-olivaceo, sicco fuscescenti, margine undulato; asci cylindrici, longe stipitati, ad apices rotundati, octospori, 50–60 × 5–7 μ; ascosporae uniseriatae, hyalinae, globosae, glabrae, 3.5–4 μ in diametro; paraphyses hyalinae, eramosae, ascos superantes, ad apices 1.5 μ; hypothecium pallidum, plectenchymaticum; cortex pseudoparenchymaticum, brunneum, cellulis parvis, crassitunicatis hexagonis ad marginem clavatis compositum.

Apothecia 0.2–0.5 mm in diameter, hypophyllous on black circular phyllacharoid stromata 1–1.5 mm in diameter, single or caespitose, cupulate, substipitate, soft-fleshy, hymenium citrine drab or grayish olive, black when dry, exterior fuscous to olivaceous black, finely pulverulent, margin undulate; asci cylindrical, long stipitate, rounded at the tips, not turning blue with iodine, 8-spored, 50–60 × 5–7 μ; ascospores uniseriate, hyaline, globose, smooth, 3.5–4 μ in diameter; paraphyses hyaline, unbranched, exceeding the asci, 1.5 μ in diameter at the tips; hypothecium pale yellowish, plectenchymatic; cortical layer pseudoparenchymatic, composed of dark thick-walled hexagonal cells, changing to clavate hyphal ends at the margin.

On sterile stromata of Phyllachoraceae (?) in leaves of unknown tree, Trinidad: Arima, [1912-1913], R. Thaxter. No date is given on the label

[1] Color readings made from RIDGWAY, R., *Color standards and color nomenclature*. Washington, D. C., 1912.

with this specimen. It was presumably collected during Thaxter's stay in Trinidad in the winter of 1912–1913 (Mycologia **25:** 79. 1933).

Several species of Discomycetes have been described as parasitic on or associated with species of the Dothideales, most of them differing, however, from *Mollisiella* in having ellipsoid or oblong spores, as well as in other characters. Species of *Mollisiella* are frequently associated with other fungi of various families in the Basidiomycetes and Ascomycetes. *M. anonyma* Rehm found on *Auerswaldia baccharidis* Pat. in Ecuador is apparently the only member of the genus growing on a host fungus in the Dothideales. The Trinidad fungus differs from *M. anonyma* in having darker apothecia and larger spores; the same characters also distinguish *M. trinitensis* from another species from Ecuador, *M. myriostylidis* Rehm, described on leaves of *Myriostylis* in association with black sclerotia.

3. **Ombrophila fusco-purpurea,** sp. nov. (Fig. 2)

Apothecia sessilia vel substipitata, dispersa vel gregaria, gelatinoso-carnosa, cupulata usque patellata, 3–5 mm in diametro, violaceo-brunnea, sicca atro-violacea, hymenio concolori, extus minute pruinosa; asci cylindrici, brevi-stipitati, ad apices rotundati et subattenuati, poro ope iodi caerulescenti, octospori, 90–100 × 7–8 μ; ascosporae infra uniseriatae, supra irregulariter biseriatae, unicellulares vel pseudoseptatae, subhyalinae usque pallide brunneolae, longe ellipsoideae vel fusoideae, 13–15 × 3–4 μ; paraphyses filiformes, ad apices subcurvatae flavidulae et usque ad 3–4 μ inflatae; stratum subhymeniale 200–300 μ crassum, gelatinosum, hyalinum; cortex subhyalinus, parvi-cellularis, caespitulis hypharum obscuriorium praecipue ad marginem obsitus.

Apothecia sessile to substipitate, scattered or gregarious, gelatinous-fleshy, shallow cupulate to patellate, 3–5 mm in diameter, sorghum brown to Hay's brown, drying dark vinaceous black, hymenium concolorous, externally slightly pruinose; asci cylindrical, short stipitate, rounded and slightly attenuated at the tips, pore bluing with iodine, 8-spored, 90–100 × 7–8 μ; ascospores uniseriate below, irregularly biseriate above, unicellular or pseudoseptate, subhyaline to pale brownish, straight or slightly curved, long-ellipsoid to fusoid, 13–15 × 3–4 μ; paraphyses filiform, slightly curved, yellowish and inflated to 3–4 μ at the tips; subhymenial layer 200–300 μ thick, gelatinous, hyaline, of loosely woven hyphae; cortical layer thin, subhyaline, pseudoparenchymatic, with clumps of darker cells scattered over the surface, particularly toward the margin.

On decaying wood on ground in forest, Bolivia: Riberalta, February 2, 1948, E. J. H. Corner *1231*.

The distinctive characters of this Bolivian *Ombrophila* are its violaceous brown apothecia

FIGS. 1-3.—1, *Mollisiella trinitensis*, × 20; 2, *Ombrophila fuscopurpurea*, ×4; 3, *Polydiscidium martynii* Wakef., ×1.

and narrow spores. Apothecia of several other species of the genus are described as tinged with lilac or violet, but are all whitish or pallid. Darker species, such as *O. aterrima* Mass. and *O. nigrescens* P. Henn., lack the brownish coloration of *O. fusco-purpurea* and differ also in the shape of the ascospores.

4. **Polydiscidium martynii** Wakef. (Fig. 3)

On rotting log, Trinidad: Mora Forest, April 1913, R. Thaxter.

Polydiscidium martynii was described in 1934 (Kew Bull. Misc. Inform. **1934:** 256, fig. 2), and so far as the writer is aware it has not been reported since the original collection from British Guiana in 1929. Apparently it is a rare species, since so conspicuous a fruiting body would scarcely escape notice. Thaxter's specimen from Trinidad consists of a compact, densely branched black mass with small apothecia at the tips of the branches, the compound fructification measuring 5 × 3 cm and 1–2 cm high when dried. Thaxter's note with his specimen, labeled as "strange Discomycete" reads: "five times as large when fresh." The asci measure 45–50 × 5–7 μ; the ascospores are pale brown, uniseptate, 7–10 × 3–5 μ, very slightly larger than noted for the type specimen.

5. **Rutsroemia boliviana,** sp. nov.

Apothecia in areis atratis petiolorum disposita, stipitata, usque 6 mm in diametro, coriacea, cupulata, lutea vel ochraceofulva, sicca rubra usque rubro-castanea, hymenio brunneo-rubro, stipite fusco-ferrugineo, 2–12 mm longo, margine subcrenato; asci cylindrici, poro ope iodi caerulescenti, basim versus attenuati, octospori, 90–100 × 10–12 μ; ascosporae uniseriatae, hyalinae usque pallide brunnescentes, suballantoideae apicibus obtuse rotundatis, guttulatae, 14–15 × 4–5 μ; paraphyses filiformes, ad apices brunnescentes et usque ad 2 μ inflatae; hypothecium tenue; stratum medianum 300–400 μ crassum, ex hyphis tenuibus intertextis compositum; cortex ex hyphis crassetunicatis brunneis ad caespitulos marginales agglutinatae compositum.

Apothecia on blackened areas of leaf petioles, stipitate, up to 6 mm in diameter, coriaceous, wrinkled when dry, yellow to ochraceous-tawny when fresh, morocco red to garnet brown dried, hymenium Victoria lake to maroon, stipe 2–12 mm long, fuscous-ferruginous, margin slightly crenate; asci cylindrical, pore bluing with iodine, gradually attenuated toward the base, 8-spored, 90–100 × 10–12 μ; ascospores uniseriate, hyaline to slightly brownish, suballantoid with ends obtusely rounded, having one large central guttule and a smaller one at each end, 14–15 × 4–5 μ; paraphyses filiform, brown and slightly swollen to 2 μ at the tips; exciple composed of a thin hypothecium, an intermediate layer 300–400 μ thick of fine brown interwoven hyphae, and a cortex of heavy, thick-walled brown hyphae agglutinated in clumps which form the crenate margin.

On dead petioles of *Bertholletia* in forest, Bolivia: Conija, January 31, 1948, E. J. H. Corner *1217*.

Rutstroemia boliviana is similar in many respects to *R. sydowiana* (Rehm) W. L. White, which occurs on leaves of *Quercus* and *Acer* in Europe and North America. While resembling in color the following species from Brazil, it differs from the latter in having a longer stipe and larger asci and ascospores.

6. **Rutsroemia corneri,** sp. nov.

Apothecia stipitata, in venis foliorum atratis epiphylla, subcoriacea, patellata usque convexa, 1–4 mm in diametro, sulphurea, sicca badia, hymenio concolore, margine tenui, revoluto, stipite 0.5–1 (–2) x 0.2–0.3 mm; asci cylindrici, brevi-stipitati, ad apices rotundati et crasse tunicati, octospori, poro ope iodi exigue caerulescenti, octospori, 75–80 (–90) x 7–10 μ; ascosporae 1–2-seriatae, hyalinae, reniformes usque lunatae apicibus obtusis, guttulatae, 10–12 x 3–4 μ; paraphyses simplices vel ramosae, granulosae, ad apices viridi-luteae vel viridi-brunneae et subinflatae; hypothecium tenue, ex hyphis pallide brunneis compositum; stratum medianum crassum, plectenchymaticum, ex hyphis pallide brunneis tenui-tunicatis laxe intertextis constitutum; cortex obscurior, pseudoparenchymaticus, hyphis fasciculatis crassis atrobrunneis strigosus.

Apothecia short- to long-stipitate, epiphyllous on blackened leaf veins, subcoriaceous, patellate to convex when fully expanded, 1–4 mm in diameter, clear sulphur yellow when fresh, mahogany or ox-blood red to maroon in dried specimens, hymenium concolorous, margin thin, uneven, stipe 0.5–1 (–2) x 0.2–0.3 mm; asci cylindrical, short-stipitate, rounded and wall thickened at the apex, 8-spored, 75–80 (–90) x 7–10 μ, pore faintly blue with iodine; ascospores 1–2-seriate,

hyaline, reniform to lunate, obtuse at the ends, having two large guttules, 10–12 x 3–4 μ; paraphyses simple or branched, granular, greenish yellow or greenish brown and slightly swollen at the tips; hypothecium of thin, pale brown parallel hyphae; intermediate layer very thick plectenchymatic, composed of pale thin-walled very loosely interwoven hyphae; cortex darker, subparenchymatic, streaked with fascicles of thick dark brown hyphae.

On the upper surface of dead leaves, Brazil: Corcovado, Rio de Janeiro, December 4 and 8, 1948, E. J. H. Corner *374* (*type*) and *1221*. Thin black lines along the leaf veins are the only indication of any stromatic development in this fungus. The apothecial characters are clearly those of a foliicolous *Rutstroemia*, similar in color and dimensions of the asci and ascospores to *R. renispora* (Ell.) W. L. White, a species found only on leaves of *Nyssa* in the eastern United States.

7. **Trichoglossum peruvianum,** sp. nov.

Ascophora angusto-clavata vel clavato-cylindrica, fuscoatra, 1–2.5 cm alta, parte fructifera dimidium investienti, interdum compressa, 1.5–2 mm in diametro, parce setosa; stipes aequalis, ater, setosus, 5–10 x 1 mm; asci longe cylindrici, ad apicem abrupte et basim versus gradatim attenuati, poro ope iodi caerulescenti, octospori, 120–130 x 8–11 μ; ascosporae elongato-fusoideae, in centro crassiores et utrinque attenuatae, saepe infra acutiores, olivaceae, uniformiter 7-septatae, 50–75 x 2.5–3.5 μ, plerumque 66 x 3.5 μ; paraphyses septatae, infra tenues et hyalinae, supra abrupte usque 5–6 μ inflatae apicibus clavatis rectis vel leniter recurvatis, subhyalinae usque pallide brunnescentes; setae atro-brunneae, ad basim subconstrictae et pallidiores, ad apices acutae, 150 x 5–6 μ.

Ascophores narrow-clavate to clavate-cylindrical, fuscous black, 1–2.5 cm high, the fruiting portion covering about half the length, occasionally compressed, 1.5–2 mm in diameter, sparsely setose; stipe even, black, setose, 5–10 x 1 mm; asci long-cylindrical, narrowed sharply at the apex and gradually toward the base, pore blue with iodine, 8-spored, 120–130 x 8–11 μ; ascospores elongate-fusoid, broadest near the center and narrowed toward both ends, often more acutely below, olivaceous, uniformly 7-septate, 50–75 x 2.5–3.5 μ, mostly 66 x 3 5 μ; paraphyses septate, slender and hyaline below, abruptly inflated above to 5–6 μ, the clavate tips erect or slightly recurved, subhyaline or pale brownish; setae dark brown, slightly constricted and paler at the base, acute at the tips, 150 x 5–6 μ.

On the ground in forest, Peru: Iquitos, April 11, 1948, E. J. H. Corner *1233*.

The ascospores in this species are noticeably uniform in septation and size, being invariably 7-septate and a very large percentage measuring 65–67 μ in length. The asci are smaller and the ascospores narrower and more acute than those of *Trichoglossum confusum* Dur., resembling those of *T. octopartitum* Mains in shape, but considerably shorter.

Prove all things; hold fast that which is good—ST. PAUL.

ZOOLOGY.—*A new* Eulithobius, *with a key to the known American species* (Chilopoda: Lithobiidae).

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(Received May 14, 1958)

It seems characteristic of the rich lithobiid fauna of temperate North America that it is in general highly endemic. The same can be said for the lithobiids of western Europe, so that not only is each region inhabited by species which are for the most part peculiar to itself, but many of the species-complexes—some regard them as genera or subgenera—appear to follow suit. The Appalachians, the Southwest, and the Pacific coast all support genera many of which have no apparent counterparts or representation in the western Palearctic, though a persistent Asian flavor is quite often evident.

Eulithobius can now definitely be said to be represented, however poorly, in both regions by species which are unquestionably very closely akin. Having had the uncommon opportunity of being able to compare Austrian specimens of *E. punctulatus* (C. L. Koch) (? = *validus* (Meinert))[1] directly with two of the three known American species, *sphactes* n. sp. and *fattigi* Chamberlin, I can say unhesitatingly that the generic characters and distinctive general habitus that they share seem not the result of evolutionary convergency, but of parallel descent.

The Austrian specimens differ significantly from both *sphactes* and *fattigi* in several respects, e.g.: spur VTiP is present in both American species but entirely absent in *punctulatus*; pretarsal unguiform (inner) accessory claws occur on legs 14 of *punctulatus* but not on those of *sphactes* or *fattigi*; *punctulatus* has two pectines[2] on each of the first 13 proximo- and distotarsi, whereas neither American form has two proximotarsal pectines; and perhaps most strikingly of all, in my specimens of *punctulatus* no pretarsus has an outer (setiform) accessory spur, whereas they occur on each of the first 13 legs of the American species. In most other features, however, the three are very similar.

[1] Thanks to the kindness of the late Carl graf Attems I have been able to obtain European specimens of this and a few other species, generally most uncommon in American collections. Attems had labeled them as *validus* Meinert, 1872, and had collected them at Graz, Austria. Broelemann, Verhoeff, Latzel, and Attems all equated *punctulatus*, 1847, with *validus*, 1872, though only Broelemann used the older name. The others used *validus*, evidently because it could be identified from its original description, whereas they felt *punctulatus* could not be assigned with equal confidence. But if we agree that both names apply properly to the same zoological entity, then the older Koch name should be used.

[2] See the discussion of pectines and pectinal setae following the key to species at the end of the article.

Eulithobius sphactes, n. sp.

The new species seems most like *E. fattigi*, known only from Boston, (in southcentral) Georgia, and northeastern Alabama. In both, the plectrotaxy is quite similar, as are the numbers of basal gonopod spurs and the ocellar arrangements. However, they differ most conspicuously in that the female gonopod claw is tripartite in *fattigi* but undivided in *sphactes*. In addition, the distotarsal pectines of *sphactes* are double, while those of *fattigi* are single. Finally, *fattigi* is apparently a smaller form with fewer antennal articles and prosternal teeth.

Holotype: ♂. Oklahoma, Muskogee County, Fort Gibson, Dresser's Cave. January 28, 1958; Thomas C. Barr, leg. U.S. National Museum Myriapod No. 2467.

BODY LENGTH. 29 mm. COLOR. Antennae, first 5–6 articles deep brownish red, those following becoming browner and finally yellowish. Cephalic plate, first tergite, predominantly deep red tinged with brown, the remaining tergites essentially mahogany except for areas of muscle attachment which are yellowish. Legs, first 13 with yellowish-orange prolateral surfaces, their postlateral surfaces whitish yellow to white, the tarsi entirely yellowish orange; last two pairs of legs entirely mahogany. Prosternum and prehensors reddish light brown. Sternites yellowish light brown.

ANTENNAE. Left, incomplete, with 34+ articles; right, complete, with 46 articles, 18 mm. All articles longer than wide. Vestiture increasing distally, relatively sparse on first and second, very dense distal to twelfth or so. CEPHALIC

PLATE. Wider than long (w = 3.8 mm, l = 3.5 mm); sides nearly straight, very slightly diverging anteriorly; large abrupt lateral interruptions present. Very sparsely, shortly setose. OCULAR AREA. Organ of Tömösvary and single posterior isolated ocellus both large, the latter weakly reniform. Upper ocellar series with larger, elongate ocelli, ocelli of remaining series essentially circular. 45–50 ocelli, disposed irregularly in 8–10 indistinct rows. PREHENSORIAL SEGMENT. Prosternum anteriorly sparsely setose, posteriorly glabrous. Prosternal teeth blunt, robust; 13-13, the diastema U-shaped; right porodont socket distinct, left porodont and socket totally absent.

TERGITES. Posterior angles of 6-7-9-11-13 produced; those of 9-11-13 very strongly, with long acute points; those of 7 very broad as in *Neolithobius*; those of 6 relatively shorter, apically rounded and margined. Surfaces of first two major tergites (pedal 1 and 3) smooth, succeeding major tergites tuberculate, each tiny pointed tubercle bearing a minute seta. Lateral margins of all tergites pronounced. Setae sparse, very small. LEGS 1–13. All tarsi distinctly divided, their sutures incomplete dorsally but without true condyles. Each pretarsus with a conspicuous inner (unguiform) and outer (setiform) accessory claw or spur. Pectines of distotarsi double, the setae relatively strong, decumbent; pectines of proximotarsi single. LEGS 14–15. Tarsi divided but each with a true dorsal condyle. Pretarsi without accessory claws. Penult legs each with a long, shallow, ventral prefemoral and a femoral groove; prefemur also with a dorsal groove. Inner surfaces of femur, tibia, and whole tarsus minutely porigerious. As a whole, each leg very long and thin, without sexual modifications. Ultimate legs each with a long shallow groove dorso-mesally on the prefemur; femur, and tibia without grooves. Ventrally a long shallow groove on prefemur and femur. Femur, tibia, and tarsus each minutely porigerous on inner surfaces. As a whole very thin and long (17 mm), without sexual modifications. COXAL PORES. Present on legs 12–15, i.e., 10-11-10-9. Most pores extremely elongate, occurring on each coxa in a linear series sunken in a deep groove. Last three coxae laterally armed.

POSTPEDAL SEGMENTS. Pregenital sternite relatively densely setose, medially deeply diastemate; gonopods uniarticulate, minute.

Allotype: ♀. See data for holotype.

Except for the following significant departures, the female allotype agrees closely with the holotype. Body length, 30 mm. Antennae, right absent, left was 46 articles, 19 mm long. Color as in holotype except for cephalic plate and first tergite which are less reddish and more brownish. Prosternal teeth, left 9, right 7; porodonts indistinct. Longest ultimate leg 14 mm, unmodified. Gonopods with 2 + 2 basal spurs, each evenly, gradually acuminate (not abruptly, angularly so as in *fattigi*); claw strictly single, undivided, apically sharply pointed.

MALE HOLOTYPE

	Dorsal				*Ventral*			
	*C**	*P*	*F*	*Ti*	*Tr*	*P*	*F*	*Ti*
1		amp	ap	a		mp	amp	amp
2		amp	ap	ap		amp	amp	amp
3		amp	ap	ap		amp	amp	amp
4		amp	ap	ap		amp	amp	amp
5		amp	ap	ap		amp	amp	amp
6		amp	ap	ap		amp	amp	amp
7		amp	ap	ap		amp	amp	amp
8		amp	ap	ap		amp	amp	amp
9		amp	ap	ap		amp	amp	amp
10		amp	ap	ap		amp	amp	amp
11	a	amp	ap	ap		amp	amp	amp
12	a	amp	ap	ap	m	amp	amp	amp
13	a	amp	ap	ap	m	amp	amp	amp
14	a	amp	p	p	m	amp	amp	am
15	a	amp	p		m	amp	amp	am

* C = coxa, P = prefemur, F = femur, Ti = tibia, Tr = trochanter; a = anterior spur, m = medial, p = posterior.

Plectrotaxy as in the holotype, except that DCA begins on 10 rather than 11.

Paratype: ♂. See data for holotype.

Except for the following, very similar to the holotype. Body length, 26 mm. Antennae, right broken, 38+ articles; left with 46 articles. Prosternal teeth, right 8, left 9; porodonts large and distinct.

Plectrotaxy differing from that of holotype as follows: 15V = 01331 (recently regenerated); DFA = 1–12, DTiA = 1–12.

Paratype ♂. See data for holotype.

Differing significantly in the following features: body length 24 mm; antennae, right broken, 21+, left with 47 articles; prosternal teeth, left 7, right 9, porodonts distinct. Plectrotaxy unknown, most legs lost.

AMERICAN SPECIES OF EULITHOBIUS

The following key should usually facilitate the identification of the three forms known presently from the United States. It is admittedly weak in

its attempt to separate the males, especially those of *hypogeus* which are known to me only through the original description. There should be no problem in distinguishing between either sex of *sphactes* and *fattigi*: the pectinal setae of the distotarsi alone will suffice. But since plectrotaxy seems untrustworthy and many of the important details of *hypogeus* are unknown, we cannot predict with certainty at this time how its males can be expected consistently to differ from those of the other species.

1a. Females 2
1b. Males 4
2a. Gonopod claw undivided; basal spurs 2 + 2, each apically evenly, gradually acuminate, not abruptly or angularly so. Distotarsi 1–13 each with 2 pectines ..... *sphactes*, n. sp.
2b. Gonopod claw tridentate; basal spurs 2 + 2 or 3 + 3 (in *fattigi* each apically abruptly, angularly acuminate). Distotarsi 1–13, at least of *fattigi*, each with one pecten 3
3a. Basal spurs of gonopod 2 + 2 ..... *fattigi* Chamberlin
3b. Basal spurs of gonopod 3 + 3 ..... *hypogeus* Chamberlin
4a. Antennal articles of adults numbering on the order of 35–37. Ocular area apparently not containing the usual large single posterior ocellus. (15D = 10210, 15V = 01321, 14V = 01331)[3] ..... *hypogeus* Chamberlin
4b. Antennal articles of adults numbering on the order either of 37 or 46–47. Ocular area with a clearly separated larger posterior ocellus. (15D = 10310, 15V = 01331, 01332, 14V = 01331, 01332)[3] 5
5a. Distotarsi 1–13 each with two pectines. Antennal articles varying around 46 ..... *sphactes*, n. sp.
5b. Distotarsi 1–13 each with but one pecten. Antennal articles varying around 37 ..... *fattigi* Chamberlin

[3] There is reason to suspect that the quantitative plectrotaxic formulae for legs 14 and 15 are not invariable, hence are not altogether reliable, at least in the case of these species.

CONCERNING THE PECTEN AND PECTINAL SETAE

A new morphological character, never heretofore employed, has proved most useful, indeed indispensible, in the study of these species.

If we examine the ventral surface of any of the first thirteen tarsi of *sphactes*, we find setae arranged in two ways: A) randomly disposed as on the dorsal surface, these setae inclined at different angles and varying somewhat in length and thickness; B) disposed in one or more rows parallel to the axis of the tarsus, these setae strongly, uniformly decumbent, equal in length and width, and slightly stouter than the others. If these seriate setae were longer and more curved, and if their rows were dorsal, they might easily remind us of the calamistrum of a cribellate spider. Since such a row of setae roughly resembles a kind of comb or rake, I have named it a pecten (plural, pectines), and its constituent setae, pectinal setae.

In *sphactes* the proximal tarsal article (the proximotarsus) bears one pecten, as does that of *fattigi*, but there are two such pectines in the European *punctulatus*. The distotarsus of *sphactes* bears two pectines, as does that of *punctulatus*, while in *fattigi* we find only one.

This character promises to resolve problems in certain other lithobiid groups where a number of significant pectinal conditions have been identified. In some of the smaller forms, e.g. *Nadabius pullus* (Bollman), the pectinal setae, though less obvious, are still distinctive in being strongly decumbent and seriate, hence identifiable.

ZOOLOGY.—*A new nereid worm from Warm Mineral Springs, Fla., with a review of the genus* Nicon *Kinberg.*[1] OLGA HARTMAN, Allan Hancock Foundation, University of Southern California. (Communicated by Fenner A. Chace, Jr.)

The discovery of a unique fauna in Warm Mineral Springs, Sarasota County, Fla., by Dr. James Lackey, led to the find of a small nereid which exists in flourishing populations in an environment which is unusual in its high temperatures and its concentrations of certain minerals. The species is here newly described and its affinities with other species of the genus related. The type is deposited in the United States National Museum (no. 29627).

Family NEREIDAE

Genus **Nicon** Kinberg, 1866

Nicon lackeyi. n. sp.

Figs. 1–5

Ovigerous adults measure 5 to 6 mm long and are 0.3 mm wide without parapodia; the body consists of 33 or fewer setigerous segments. The prostomium is trapezoidal in outline, about as long as wide and has a pair of cirriform frontal antennae, each about as long as the prostomial length. The four eyes are moderately large, reddish in color, and subcircular in outline; they are located on the posterior third of the prostomium, with the two of a side nearly touching and widely separated from those of the opposite side. Palpi are large and project in front of the prostomium (Fig. 1) or they are directed ventrally and best seen from below.

The pharynx, seen only by dissection and in cleared whole mounts, is believed to lack paragnaths or papillae, as characteristic of the genus *Nicon* Kinberg. The paired maxillae or jaws are very delicate, translucent pale yellow in color, with the two of a side similar; each is longer than wide and broadest at the base, tapering to a slender, distally recurved tip and six lateral, subequal, oblique teeth along the cutting edge (Fig. 3). The teeth arise from an elevated ridge and are difficult to see unless the jaw piece is rolled on edge.

The first visible segment is very short and bears the four pairs of peristomial cirri. The dorsal and ventral cirri of the first pair are short and the first are inflated in their basal half (Fig. 1). The cirri of the posterior pairs are slenderer and taper distally. The longest, or second dorsal cirri, are about as long as the first seven setigerous segments.

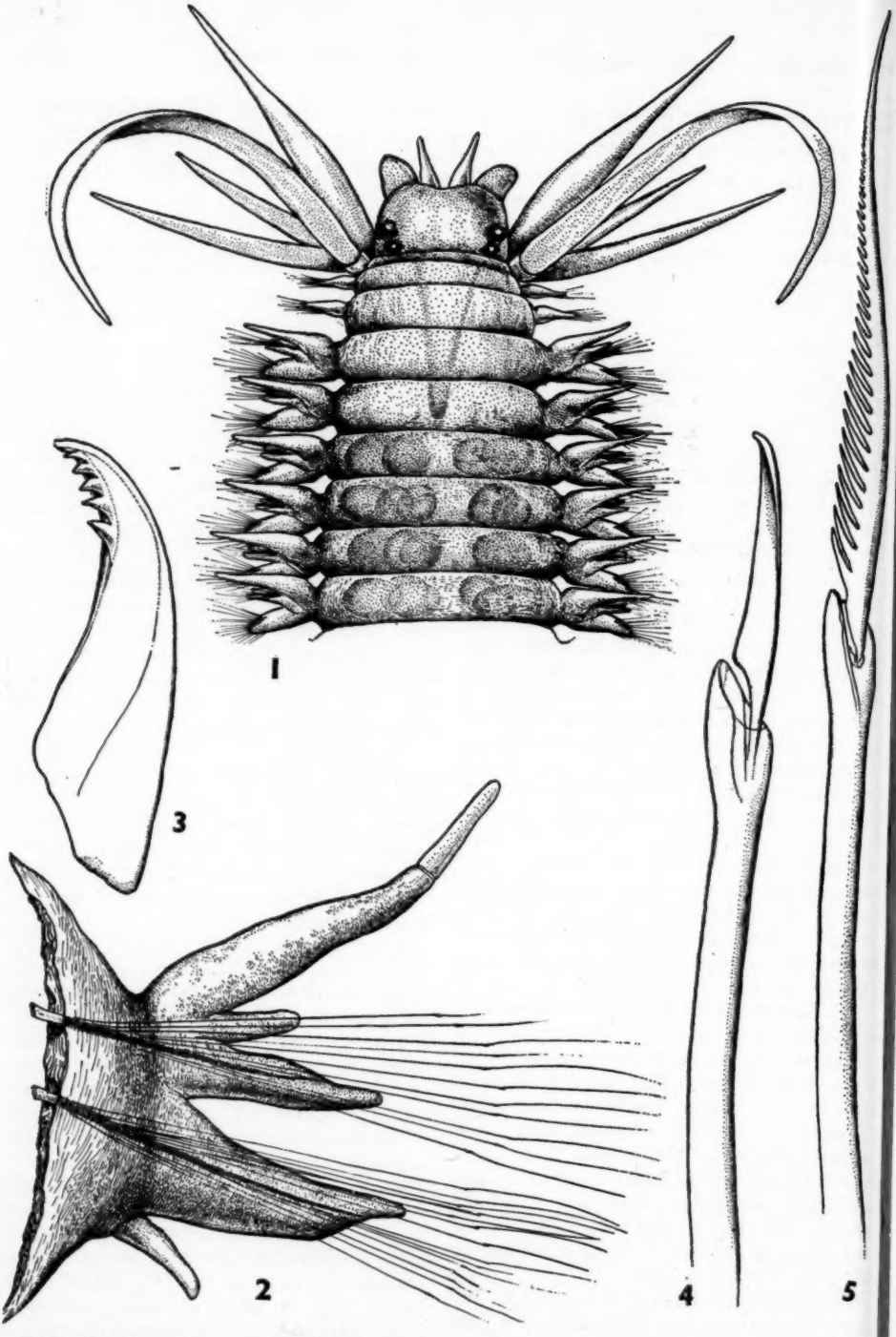
The second visible segment is the first setigerous. The parapodia of this and the second segment are small and uniramous; they lack dorsal cirri and notopodia. From the third segment the parapodia are larger and conspicuous; they have dorsal cirri and well-developed biramous parts. Typical parapodia have well-developed, laterally projecting lobes with neuropodia somewhat the larger; their lengths increase slightly in more posterior segments. The dorsal cirrus, or cirrophore, is long, tapers distally, and merges directly into the dorsal cirrus (Fig. 2) so that the fusion of the two parts is not always clearly made out. The distal end of the dorsal cirrus extends obliquely out to the ends of the long setae.

The notoacicular lobe of anterior segments has long superior and inferior lobes; the upper one is postacicular and the lower is preacicular. In anterior segments these two lobes are about equally long. In middle segments the upper lobe diminishes in length and in posterior segments both lobes decrease gradually in size so as to be absent far back.

Notopodia are distally oblique, with the longest edge below. They are provided with single pale yellow acicula and 7 to 12 composite spinigerous setae with homogomph articulation. Neuropodia resemble notopodia but are distally oblique in the opposite direction, with the superior edge the longer one. They also have single embedded yellow acicula, completely covered or the distal tip may emerge for a short distance just below the uppermost part of the lobe.

Neuropodial setae are of three kinds. The uppermost are homogomph spinigers, like those in notopodia. They are accompanied by two or a few heterogomph spinigers with cutting edge conspicuously serrated (Fig. 5). The latter are shorter than the others and easily overlooked. Subacicular setae are heterogomph falcigers in which the length of the appendage varies from long to short, or 4 to 10 times as long as wide;

[1] Contribution no. 228 of the Allan Hancock Foundation.



FIGS. 1–5.—*Nicon lackeyi*, n.sp.: 1, Anterior end including first 8 segments, in dorsal view, × 112; 2, twelfth parapodium in anterior view, × 635; 3, maxilla dissected from retracted pharynx, × 1,400; 4, inferior heterogomph falciger from a median parapodium, × 1,210; 5, neuropodial heterogomph spiniger with serrated edge, × 1,210.

the shortest are in inferiormost positions. The cutting edge is smooth (Fig. 4). A typical or median parapodium has 7 to 12 spinigerous notosetae, 7 homogomph neurosetae, 2 heterogomph spingers, and about 7 heterogomph falcigers.

The anal end terminates in a pair of short, triangular ventral lobes at the sides of the anal pore, and a pair of long, laterally directed cirriform processes, their length about that of the last six segments.

Ova are giant in size and few in number, with at most four to six in a segment, present in most of the body behind the pharyngeal region (Fig. 1). Development is probably direct, without epitoky. Color in life is dusky overlain by a greenish tinge, with most pigment concentrated at the sides of the prostomium and in the segmental grooves.

The specific name is for Dr. James Lackey, to whom I am indebted for the collection and the physical data (below). Dr. Lackey was able to collect living adult stages and kept them alive in the laboratory where they continued to give rise to young stages.

Locality.—"About 2 miles south of the bridge where U. S. highway 41 crosses the Myakka River in Sarasota County, in a large first magnitude spring, with a flow of 7,000,000 to 9,000,000 gallons per day of water which has a constant temperature of 86° F., contains no dissolved oxygen, but does contain 0.162 parts per million of hydrogen sulphide. The spring also contains about 17,000 ppm of dissolved solids, principally chlorides, sodium, and potassium, and has a pH at 7.2 ± 0.2. These features are constant." These data are taken from a report by Dr. Lackey to the Florida Academy of Sciences presented at a meeting on December 6, 1957.

Genus **Nicon** Kinberg, 1866, emended Hartman, 1948

Type, *Nicon pictus* Kinberg, 1866.

This is a small genus of Nereidae, characterized for having biramous parapodia as in *Nereis* Linnaeus but with a proboscis lacking paragnaths or papillae. Notopodia are typically provided with spinigerous setae only. Neuropodia have spinigers and falcigers. Most known species are small to moderately large. Development is direct or accompanied by epitoky. Six of the ten known species are from the Western Hemisphere; the others are from the Southern Hemisphere, in extra-American areas.

The following species are regarded congeneric:

Nicon aestuariensis Knox, 1951, from New Zealand.
Nicon ehlersi Hartman, 1953, from Falkland Islands in deep water.
Nicon lackeyi, new species, from Warm Mineral Springs, Florida.
Nicon maculata Kinberg, 1866, from off La Plata, Argentina.
Nicon mexicana (Treadwell) 1942, as *Leptonereis mexicana*, from western Mexico.
Nicon moniloceras (Hartman) 1940, as *Leptonereis glauca moniloceras* from Santa Catalina Island, California and western Mexico. New combination.
Nicon pictus Kinberg, 1866, off Brazil in 20–30 fms.
Nicon punctata (Wesenberg-Lund) 1949, as *Leptonereis punctata*, from the Gulf of Iran. New combination.
Nicon tahitanus Kinberg, 1866, from Tahiti.
Nicon virgini Kinberg, 1866, from the Strait of Magellan.

KEY TO SPECIES OF NICON KINBERG

1. Neuropodia provided with some simple brown falcigers ..... *N. punctata*
   Neuropodia without simple falcigers 2
2. Notopodia with falcigers in addition to spinigers ..... *N. tahitanus*
   Notopodia with spinigers only 3
3. Peristomial cirri and prostomial antennae distally articled ..... *N. moniloceras*
   Peristomial cirri and antennae not articled .. 4
4. Peristomial cirri very short; becoming epitokous *N. mexicana*
   Peristomial cirri moderately long; development direct or becoming epitokous 5
5. Dorsal cirri inserted at terminal end of dorsal lobe ..... *N. lackeyi*
   Dorsal cirri inserted at or near superior base of dorsal lobe 6
6. Posterior neuropodia provided with 3 or 4 thick-shafted heterogomph falcigers ..... *N. ehlersi*
   Posterior neuropodia without such falcigers .. 7
7. With a long lobe behind the neuroaciculum, resembles one of main parapodial lobes and increases in size posteriorly ..... *N. pictus*
   Without such long lobe behind the neuroaciculum 8
8. In the posterior half of the body, the middle parapodial lobe is larger and longer than the dorsal lobe ..... *N. maculata*
   In the anterior part of the body the dorsal lobe is larger and broader than other lobes *N. aestuariensis*

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Milton Abramowitz

With the sudden death of MILTON ABRAMOWITZ of a heart attack on July 5, 1958, a great loss was felt by family, friends, community, and scientific world. His life was a marked departure from the so-called ivy-tower existence.

Born in 1915 to Phillip and Rose Abramowitz, he attended preparatory schools in New York. His bachelor and master's degrees as well as a gold medal for excellence in mathematics were awarded by Brooklyn College. At its inception, he started work with the Mathematical Tables Project, the scientific program of which was sponsored by the National Bureau of Standards, and at night continued his studies for his doctorate, which was granted in 1948 by New York University. As a member of the Mathematical Tables Project he saw a total of about 32 volumes published as an aid to the scientific world. During this time, he became interested in the application of commercial machines of every type to scientific computing. This interest did not waver in his lifetime. Starting with adding and accounting machines then available, he became interested in the application of the most advanced electronic digital computing machines. At the time of his death he was chief of the Computation Laboratory of the National Bureau of Standards, eagerly awaiting newer and faster machines.

In addition to the volumes published under the auspices of the Mathematical Table Project, he published many scientific papers and was influential in the publication of a large number of the 52 volumes of the Applied Mathematics Series, of the National Bureau of Standards. During the war years, he was on loan to the U. S. Navy Hydrographic office. As a result of his efforts and his interest in machine computation, the many volumes of Loran tables made their appearance. For his work, he was awarded the Meritorious Civilian Service Award by the United States Navy.

While working, he continued his teaching activities as a member of the staff of Brooklyn College and on his transfer to Washington in 1950, on the staff of the American University and the University of Maryland. His students could be found conferring with him at all hours of the day or night. The door to his office was open at all times to all those with a problem to solve. His efforts were unsparing in aiding students, colleagues and staff members. He encouraged continued schooling, obtaining of advanced degrees and the writing of scientific papers. His knowledge was eagerly imparted to all.

With all this scientific activity, he found time for marriage and family life. He was the devoted husband of Lillian Abramowitz and proud father of Barbara and Edward. Evenings, he could be found enjoying the latest plays, or playing chess or pingpong, in addition to overseeing the children's homework and caring for their fish, parakeet, duck, or neighbor's dog. His sports interests covered football, basketball, and baseball. He was an avid reader of historical works, poetry, and biographies as well as detective stories and westerns. His interest in gardening extended from vegetables to perennials. Community projects found him eager to lend a helping hand—bond drives, blood donations, scout activities, parent-teacher meetings, neighborhood improvements, religious education of children. Even do-it-yourself kits found their way into his home.

He possessed an amazingly retentive memory not only for scientific facts but also for people and places. His early interest in mathematical tables and special functions of mathematics and physics led him to the preparation of a handbook of mathematical functions, under the sponsorship of the National Science Foundation. As planned under his direction, the volume is to contain about 28 chapters with formulas, tables, and graphs of the elementary transcendental functions as well as the higher functions. He himself had already prepared the chapters on Struve functions, Coulomb wave functions, and elementary analytical methods, and was working on the chapter of spheroidal wave functions at the time of his death. He had contributed to the planning of almost all the other chapters in the volume. He felt that the wide dissemination of such a handbook among high school and college students would inspire many to scientific careers as well as aid those already working in this field.

Let us hope that his endeavors will bear fruit manyfold.

ICHTHYOLOGY.—*A study of the luminous organ of the apogonid fish* Siphamia versicolor (*Smith and Radcliffe*). TAMOTSU IWAI, Kyoto University, Maizuru, Japan. (Communicated by Ernest A. Lachner.)

(Received June 27, 1958)

The luminous organs of fish have received much attention and have been reviewed comprehensively by Harvey (1957, p. 345). Despite the fact that the luminous behavior of large numbers of both elasmobranch and teleostean species has been reported, the data available on the luminous organs of apogonid fishes are sparse and inadequate. The first information on a luminous apogonid was made by Kato (1947, p. 195). He found that *Apogon marginatus* Jordan and Snyder possesses three organs on the bend of the intestine and on either side of the rectum immediately before the anus. Iwai and Asano (1958, in press) found similar luminous organs on *Apogon ellioti* Day, and concluded that the nominal species *A. marginatus* is identical with and predated by *A. ellioti*. This was the only species of apogonid known to possess luminous organs until the silvery gland of *Siphamia* was suspected.

Siphamia, a genus of the family Apogonidae, is characterized by having a silvery gland extending from the isthmus to the lower corner of the caudal peduncle along the ventral contour of the body (Weber and de Beaufort, 1929, p. 356; Schultz, 1940, p. 404; Lachner, 1953, p. 413). The general appearance of this gland resembles the luminous organs found in certain other fish, e.g. *Paratrachichthys prosthemius* Jordan and Fowler, but no attempt has been made to clarify the function of this remarkable structure. Knowledge of whether this structure has relation to luminescence is desirable, for such information would give us a better understanding of the relationships and classification of the luminous apogonids with other members of the family. The author had the privilege of examining some specimens of *Siphamia versicolor* (Smith and Radcliffe) through the courtesy of Dr. Ernest A. Lachner of the United States National Museum. The present communication consists of observations on this material.

The author is indebted to Prof. Kiyomatsu Matsubara, under whose direction the present work was undertaken. Grateful acknowledgment is made to Dr. Ernest A. Lachner for his critical reading of the manuscript.

The study material consisted of three specimens, U.S.N.M. no. 112269, measuring 20.0–24.5 mm in standard length. These were collected from Cataingan Bay, Masbate, Philippines, on April 18, 1908, by the *Albatross* Expedition. Of these one specimen was dissected and the lower portion of the body was serially sectioned by the usual paraffin method at a standard thickness of 10 micra. The serials were stained with Mayer's hemalum and eosin.

For comparison, one specimen of the luminous berycoid, *Paratrachichthys prosthemius* Jordan and Fowler, which has a subcutaneous striated band along the lower surface of the body somewhat like *S. versicolor*, was also sectioned.

All drawings were made by camera lucida tracing, although the detailed structures were diagrammatized.

RESULTS

Siphamia versicolor is a small species attaining a standard length of approximately 30 mm and appears to be an endemic form to the Philippine Archipelago. The body is deep and compressed, the ratio of depth and width to the standard length being 2.1–2.4 and 4.6–5.4, respectively. The head is remarkably large, its ratio to the standard length being 2.1–2.5. The ground color in alcohol is dusky silver with three longitudinal brown stripes. The uppermost stripe begins on the tip of the snout and runs posteriorly along the dorsal contour of the body to the caudal peduncle. The second one extends from the tip of the snout through the eye to the caudal base. The lowermost one originates on the upper edge of the maxillary and extends backwards passing through the pectoral base to the ventral corner of the caudal pe-

duncle. Along the ventral border of the third stripe a curious silvery band lies between the isthmus and the caudal peduncle.

On the ventral aspect the band originates on either side of the brownish midline-keel of the isthmus, and extends and expands on each side posteriorly to the base of the ventral fin. At this level the band is greatest in width: it occupies a wide area between the lower edge of the pectoral base and the midline of the belly. From there it extends posteriorly in parallel branches, one on each side, and each tapers gradually to the rear at the ventroposterior corner of the caudal peduncle (Fig. 1).

Histological examination revealed that this band is the longitudinal muscle bundles lying just beneath the dermis. They are sheathed with an extraordinarily developed epimysium which is composed of opaque fibrous connective tissue (Fig. 2, A, B, C, *mb* and *fs*). The microscopic feature of this sheath is essentially the same as the reflector-like structure mentioned below. Externally, the muscle bundles are lined with thin layers of the dermis and epidermis enclosing the imbricated scales.

Structural evidence of these muscle bundles is quite similar to that of *Paratrachichthys prosthemius*, though the epimysium of the latter species is more densely dotted with melanophores. In his work on the luminous organ of *P. prosthemius*, Haneda (1957, p. 18) gave the name "filiform body" to the muscle bundles lying posterior to the base of the ventral fin and "keel muscle" to those lying anterior to the ventral base. He concluded that these structures take charge of diffusion of the light emitted from the luminous organ.

Within the body wall and immediately before the base of the ventral fin, there extends a curious organ which is composed of three distinct elements. The striking and perhaps most functional element is a compact mass of polyhedral cells lying in the middle layer of the organ. The mass itself is small, bean-like in shape (Fig. 1, *lo*). It measures 2.0 mm in length, 1.4 mm in width, and 0.25 mm in thickness in a specimen measuring 24.0 mm in standard length. The cells, forming the mass, are somewhat long and polyhedral and are packed together, not arranged in a row. The cytoplasm of each cell is filled with granular secretion stained deeply by eosin. The blood supply is evidently connected with the base of the mass.

Dorsally, the main structure mentioned above is wholly covered by an opaque stratum of fibrous connective tissue (Fig. 2, *rf*). This layer is comparatively thick, it being as thick as the mass structure, and occasionally dotted with melanophores. Its dorsal surface is exposed to the abdominal cavity and it is recognized as a white marking. This structure is virtually the same as the reflector of the luminous organ of *Apogon ellioti* (Iwai and Asano, in press). The fact that this layer covers the proximal edge of the organ like a cap would lead one to suppose that it may act as a reflector of light as is the case with the luminous organs of some fishes.

The third element, a well-defined, thick layer, is composed of a pair of longitudinal muscle bundles, and is located on the ventral side of the main structure. The cross section of these bundles is roughly elliptical in shape (Fig. 2, *le*). The arrangement and general feature of these muscle

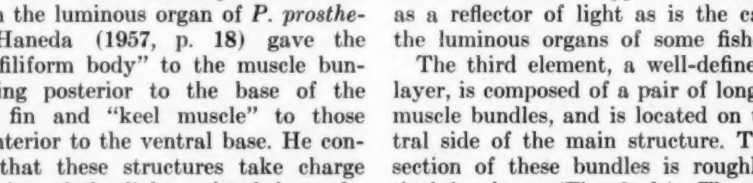

FIG. 1.—Ventral aspect of *Siphamia versicolor*, showing longitudinal muscle bundles (*mb*) and position of luminous organ (*lo*); *an*, anus.

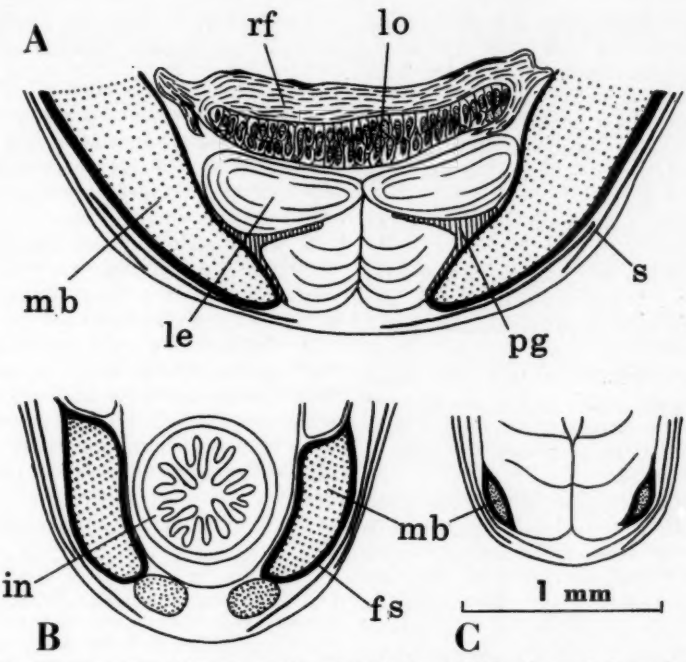

FIG. 2.—Transverse sections of lower portion of the body of *Siphamia versicolor* at levels indicated in Fig. 1 as a, b, and c.: *fs*, fibrous sheath; *in*, intestine; *le*, lens; *lo*, luminous organ; *mb*, longitudinal muscle bundle; *pg*, pelvic girdle; *rf*, reflector; *s*, scale.

bundles resemble the lens of the luminous organ of *Acropoma japonicum* noted by Haneda (1950, p. 218). The pelvic girdle is inserted between these muscle bundles and the aforementioned keel muscle.

In evaluating the results of the dissection, it seems highly probable that the mass structure of polyhedral cells lying above the pelvic girdle would be a luminous organ (Fig. 2, *lo*). Neither an opening to outside of the body nor a connection to the alimentary canal is present in this luminous organ. Photogenesis of this species, therefore, appears to be intracellular. The polyhedral cells with a granular secretion would be photogenic cells.

DISCUSSION

No definite decision in regard to the function of the curious organ in *Siphamia versicolor* is tenable, since no physiological result is available. However, it may be of value to provide a brief outline of suggestive evidence obtained by the microscopic anatomy. This may form a basis for interpreting the possible function of this organ. Insofar as it was observed, the mass structure bears, like the luminous organs of some other fishes, peculiar accessory structures such as: (1) a reflectorlike structure of fibrous connective tissue, (2) longitudinal muscle bundles which may serve as a lens, and (3) longitudinal muscle bundles with fibrous sheath lying along the ventral contour of the body. These structures as well as the position of the mass structure in the abdominal body wall, imply the possibility of the luminous function of this organ. Haneda (1957, p. 19), in making observations with living material of *P. prosthemius*, reported that by means of mechanical stimulation of the luminous organ situated near the anus, the luminescence occurs along the keel muscle and the filiform body. The latter two structures are equivalent to the longitudinal muscle bundles lying on the ventral margin of the body of *Siphamia*. This supports further the above mentioned postulation.

Lachner (1953, p. 413) wrote that the

subcutaneous glands form a hollow canal. This study indicates that these are longitudinal muscle bundles covered by the stratum of fibrous connective tissue.

There is an urgent need for examination of living specimens assigned to *Siphamia* in order to confirm their luminescence. This structure is sufficiently distinct to characterize the genus *Siphamia*, as was pointed out by various authors.

Fowler (1938, p. 40) proposed a new subgeneric name, *Aulotrachichthys*, for the deep-sea berycoids, *Paratrachichthys latus*, and *P. prosthemius*, based on the subcutaneous striated tubes of the lower body surface. Haneda (1957, p. 19) pointed out that these tubes consist of the muscle bundles and serve as an accessory structure of the luminous organ.

The luminous organ of *S. versicolor* agrees in both its position at the thoracic region and the accessory muscles bundles with that of *P. prosthemius*, but it is probably neither homologous nor analogous with that of the latter species. The fundamental differences between them are exemplified in other structures. The luminous organ of *Siphamia* consists of a compact mass of polyhedral cells with granular cytoplasm and lacks openings to the outside of the body or to the alimentary canal, whereas the organ of *Paratrachichthys* comprises ramified ducts surrounding the anus and has openings to the exterior. Photogenesis appears to be intracellular in the former species in contrast to the luminous bacteria of the latter species.

The luminous organ of *S. versicolor* also differs from that of the luminous apogonid, *Apogon ellioti*. The latter species possesses three luminous bodies composed of columnar cells with eosinophil secretions located on the second bend of the intestine and on either side of the rectum immediately before the anus. Each opens into the intestine (Kato: 1947, p. 195; Iwai and Asano: 1958, in press).

In view of the marked peculiarity shown in the luminous organ, it is conceivable that not only the differentiation of the muscle bundles but also other structural evidence of the luminous organ are enough to substantiate the generic position of *Siphamia*.

SUMMARY

1. *Siphamia versicolor* (Smith and Radcliffe) possesses a curious organ within the body wall immediately before the base of the ventral fin, which is probably luminescent.

2. The organ is lined dorsally with a structure like a reflector and ventrally with a structure like a lens. Photogenesis appears to be intracellular.

3. The silvery gland lying along the ventral contour of the body is composed of longitudinal muscle bundles sheathed with a fine stratum of fibrous connective tissue. This may act as an important element to diffuse the light emitted from the luminous organ.

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ENERGY DISTRIBUTIONS AND TEMPERATURE DETERMINATIONS IN FLAMES

The National Bureau of Standards is conducting a program of basic research, sponsored by the Air Research and Development Command, on the physical and chemical processes occurring in flames and other high-temperature gases. In this work spectroscopic methods are employed to observe hot gases in both flames and electrical discharges. The data thus obtained are proving useful not only in reaching a better understanding of the combustion process but also in the development of accurate spectroscopic methods for measuring high temperatures. In addition, the program provides information on atoms and free radicals which is applicable to upper atmosphere chemistry and physics, and chemical kinetics.

When present methods of temperature measurement are applied to certain systems of hot gases, several different temperatures are obtained. These temperatures must be related to the Thermodynamic or International Temperature Scales before valid thermodynamic calculations are possible. Detailed spectroscopic studies on well-controlled systems are thus needed to provide the basic information required in this area.

In measuring flame temperatures spectroscopically, molecular distributions are calculated from observed spectral intensities and compared with distributions predicted theoretically for certain temperatures. For the distribution calculations the relative intensities of a group of related spectral lines emitted or absorbed by the flame are first measured. Then from these relative intensity values and the known values for the probabilities of emission or absorption of radiation, the numbers of molecules in the various energy levels given rise to spectral lines are determined.

The experimentally observed distribution may also be compared with distributions predicted theoretically for a range of equilibrium temperature values. If a certain temperature can be found which has a theoretical distribution agreeing with the observed one, then this is the temperature associated with the levels under study; or when the flame is substantially in equilibrium, the temperature of the flame as a whole. However, the observed distribution doen not always correspond to any temperature value.[1] Even if it does, a parallel investigation of another group of energy levels in the same system may give a different temperature.

In using the observed distribution of molecules in the possible energy states to study rate processes and equilibrium conditions, three general types of behavior are found. Essentially they differ in the amount of interaction, or coupling, between the various groups of energy states in the system being observed. Examples of each type are discussed below.

STRONG INTERACTION

The simplest case is complete equilibrium. Here all the observed energy levels correspond to the same temperature, so that the measurements constitute a reliable temperature determination. An example of this situation is a recent investigation of the emission spectrum of iron atoms added to a hydrogen-oxygen flame.[2] Here the intensity distribution in the emission spectrum corresponds to a temperature of 2845°K. The temperature determined from the emission spectra of OH radicals in the flame is 2770°K, which is also the temperature determined from the corresponding absorption measurements. The temperature calculated from the known energy release in the flame is 3100°K. The approximate agreement of these values indicates that the flame is essentially in equilibrium, that the several groups of energy levels have interacted strongly enough to come to the same temperature. Here the observed distributions do not depend on the details of the excitation process.

NO INTERACTION

A second, quite different type of behavior is found in observing the OH radical emission spectrum in the reaction zone of an acetylene-oxygen flame.[3] Under certain conditions observations reveal an abnormal rotational dis-

[1] See *Incomplete equilibrium and temperature measurement*, by C. M. HERZFELD, Journ. Washington Acad. Sci. **46**: 269. 1956.

[2] *Spectroscopic study of electronic flame temperatures and energy distributions*, by H. P. BROIDA and K. E. SHULER, Journ. Chem. Phys. **27**: 933. 1957.

[3] *Rotational temperatures of diluted flames*, by W. R. KANE and H. P. BROIDA, Journ. Chem. Phys. **21**: 237. 1953.

tribution in the electronically excited state, corresponding to a temperature approaching 10,000°K. However, the heat released in burning is sufficient to produce an equilibrium temperature no higher than 2,000°K. Results of this kind have been a puzzling contradiction for some time, since molecules which have such an excess of rotational energy are known to lose this excess quickly in collisions with other gas molecules at a lower temperature. Why there seems to be no interaction between the abnormally populated rotational levels and other groups of energy levels in the system has not been understood.

This contradiction has now been resolved by the following considerations.[4, 5] The observed electronically excited OH molecules are originally formed with a large excess of rotational energy. If this excess is to show up in the spectrum, the molecules must radiate before they have undergone enough collisions with other molecules in the flame gases to bring their energy back to normal. A study of the fluorescence of these OH radicals in flames has shown that this electronic excitation energy is lost at almost every collision, so that the excited molecules do not live long enough in the flame to undergo the number of collisions—approximately 10—which are necessary to affect their rotational energy. Changing conditions in the flame cannot change the distribution unless they affect the excitation process itself.

In the experiments bearing on this point, an acetylene-oxygen flame burning at a few thousandths of an atmosphere pressure is illuminated by an intense source of light. This light is absorbed by the OH radicals in the burnt gas. If there were no deactivating collisions, all of the light absorbed would be re-radiated as fluorescence. However, the fluorescence is found to be much weaker than expected. Therefore, most of the energy is lost in deactivating collisions, which must have a high efficiency.

PARTIAL INTERACTION

In the third possible type of behavior, the interaction between the several groups of energy levels is only partial, rather than being almost complete as in the hydrogen-oxygen flame, or non-existent as in the abnormal OH spectrum mentioned above. In this intermediate case the distribution of molecules in the accessible energy levels, and therefore the apparent temperature, is affected by molecular collisions. These collisions tend to adjust the observed distribution to a form consistent with the distributions in other groups of energy levels and with the total energy content of the system. A theoretical treatment of certain processes of this type has recently been completed[6] and relevant experimental data have been obtained from atomic flame and afterglow systems.[7, 8] Obtaining such data is complicated by the difficulty in distinguishing between changes in an observed distribution due to changes in the excitation process, and changes in the distribution due to collisions following excitation. With these problems in mind, studies are being made of the spectra emitted when nitrogen atoms react with introgen and oxygen molecules and with simple organic molecules. Such studies have shown, for example, the rotational distribution of electronically-excited CN radicals to be so strikingly affected by pressure increases that only at high pressures can a well determined temperature be assigned to this group of energy levels.

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[6] *Studies on nonequilibrium rate process. I. The relaxation of a system of harmonic oscillators*, by E. W. Montroll and K. E. Shuler, Journ. Chem. Phys. **26**: 454. 1957.

[7] *Spectra of afterglows and discharges from nitrogen-oxygen mixtures*, by U. H. Kurzweg, A. M. Bass, and H. P. Broida, Journ. Mol. Spec. **1**: 184. 1957.

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